



# Autumn Leaf Litter Composting Trial 2011 - 2012

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We cannot do this alone. We work closely with a wide range of partners including government, business, local authorities, other agencies, civil society groups and the communities we serve.

# Executive Summary

In Autumn 2011 the Environment Agency conducted a small scale trial with four local authorities to gather information about whether leaf litter from street sweepings collected in the period September to December 2011 was suitable for composting and, thereafter, for spreading to land.

The leaf litter trial has provided a small dataset which shows areas of concern in relation to nickel, copper, chromium, molybdenum, zinc and hydrocarbons.

However, not all of the data has been submitted and the data has also not been validated effectively in terms of the sampling methodology. There is also some abnormality in data between local authorities where the source of contamination is not understood.

The outcomes from this trial signal the need for a precautionary approach to composting of this waste. This is due to the presence of metals such as nickel, copper, chromium, molybdenum, zinc and other contaminants. Our current guidance therefore remains unchanged.

We will continue to review evidence provided on the composting of separate leaf litter collections. We are working with the industry about this. Local Authorities interested in undertaking trials for composting of leaf litter can contact AfOR (Association for Organics Recycling) who have expressed a willingness to oversee trials.

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## Introduction

The Environmental Permitting (England and Wales) Regulations 2010, which came into force on 6 April 2010, clarified how composting of biodegradable wastes is regulated under exemptions and environmental permits. The exemptions and standard rules permits exclude the composting of street sweepings and ultimately spreading this waste to land for beneficial use because they are a non-source segregated waste and there is a risk of contamination.

The Compost Quality Protocol does not include street sweepings as an input waste and therefore any compost produced is waste. The Environment Agency considers compost produced from street sweepings to be a Compost-Like Output (CLO), which can only be spread to non-agricultural land.

We recognise that street sweepings consisting of freshly deposited leaf litter collected in rural areas may have low levels of contamination and that the material may be a suitable feedstock for producing compost if properly treated and managed. However, due to lack of available data to support this assumption the Environment Agency proposed a trial to assess contamination levels in leaf litter collected over the autumn period and to gather data on nutrients, heavy metals and oil contamination.

In Wales, the Welsh Government have required that after 2015 compost must meet the Compost Quality Protocol to be considered “recycled”. As street sweepings, including autumn leaf litter, are not included in waste inputs to the Compost Quality Protocol, the composting and spreading of this waste would count as “recovery” only.

As a result, we ran a small trial in Wales in autumn 2011. Four Welsh local authorities gathered data on the quality of autumn leaf litter as a potential feedstock for compost and assessment of levels of contamination.

The Environment Agency published guidance in May 2012 on the management of street sweepings and how local authorities can report under the Landfill Allowances Scheme (LAS) in Wales and Landfill Allowances Trading Scheme (LATS) in England to ensure a consistent approach across the country. Subsequent to this trial we promised that we would review this guidance.

## Objectives

- To collate data to assess the level of contamination and the nutritional benefit from autumn leaf litter as a feedstock in aerobic composting
- Use the data collected from this trial to determine how and when leaf litter from street sweepings can be sustainably and safely managed in the future based on evidence.
- Consider risk to end users, based on evidence and advise on appropriate use
- To seek solutions for local authorities for the management and reporting of recycling and recovery.

## Scope of the Trial

### Overarching conditions

To ensure that leaf litter was managed properly during the course of the trial and that the data collected is consistent across the local authorities, the following conditions were specified.

The trial allowed leaf litter to be composted and for an application to be made to the Environment Agency as to where and how this compost could be used.

The trial did not allow the treatment of street sweepings to remove contaminants or recover grit (apart from screening prior to composting), which requires an environmental permit.

The local authorities and their sites agreed to comply with the conditions of the trial.

If the local authorities did not comply with these conditions then we would stop their participation in this trial.

### **Input wastes**

This trial ONLY applied to street sweepings which:

- were collected between September and December 2011 (extended from November 2011)
- consisted of autumn leaf fall or plant material swept up from cutting back the verges.
- were clean and free from easily identifiable other litter e.g. cans, plastic items.

This trial DID NOT apply to street sweepings collected:

- from urban areas, where it is expected that grit or other contaminants would form a high proportion or majority of the waste.
- when the roads have been gritted.
- from gully pots (gully suckings).
- from areas where road resurfacing works are being undertaken.
- from areas where it is known that pollution has occurred (e.g. traffic accident).

### **Composting**

Clean leaf litter from rural street sweepings was to be composted under the following conditions:

- Leaf litter must be composted separately from other biodegradable waste.
- The compost must be batch tested to assess contamination.
- Analysis of the compost must include Poly Aromatic Hydrocarbons (PAHs) and Oil Identity (to identify the source of any hydrocarbons found), Potentially Toxic Elements (PTEs), heavy metals and organic matter as well as nitrogen, phosphorus and potassium.
- No more than 500 tonnes of street sweepings should be stored or treated at any one time (including storage prior to composting and maturation).
- If any composting takes place on concrete and leachate is collected then the leachate was also analysed.

### **Use of resultant compost**

For the compost produced as part of this trial we may let this be spread to land if we determined that the compost was suitable for spreading. The information required below was submitted to specific Environment Agency officers at least 25 working days prior to spreading:

- a completed deployment form;
- maps of the land to be spread;
- soil analysis;
- waste analysis, as outlined in the section on composting;
- an agricultural benefit statement (written by a person with appropriate technical expertise) ;
- and a pollution risk assessment.

## Methodology

In March 2011, eight predominantly rural Welsh local authorities were invited by letter to take part in the trial. They were asked to confirm in writing:

- they wanted to be involved in the trial
- they would follow the conditions of the trial (previous letter enclosed)
- the name and addresses of the sites where composting and spreading will take place.
- that those sites agreed to comply with the conditions of the trial.

Four local authorities, Gwynedd, Isle of Anglesey, Ceredigion and Powys, agreed to take part in the trial, operating at a number of different sites across North and Mid Wales. The majority of these sites were operating under the paragraph 12 exemption, whilst one has a bespoke compost permit and a treatment facility.

All of these sites were operating as open windrow aerobic composting facilities. They were requested to ensure that their leaf litter was composted separately to any other wastes at their sites and sampled in batches.

## Leaf Litter Trial Results

The results have been tabulated showing the number of samples of untreated leaf litter compost collected as part of this trial that have been analysed for that parameter and then the minimum, median and maximum values for each parameter. Not all analysis was undertaken on all samples so the number of samples has been included as an indication of the potential validity of that data set.

The PAS 1001 requirements for quality compost have been included in the table as a comparator. PAS 100 provides upper limits for compost quality including limits for the following:

- Pathogens
- Potentially Toxic Elements (PTEs)
- Stability / maturity
- Physical contaminants
- Plant response, weed seeds and propagules.

As discussed previously, street sweepings are not listed as an input waste to the Compost Quality Protocol. However, this standard was set to improve confidence in composted materials among end users, specifiers and blenders, and will help producers differentiate products that are safe, reliable and high performance. The data from this trial has only assessed PTEs in the composts, not any of the other parameters.

As an additional comparator, the table also includes the level of each individual element if the leaf litter compost was spread to land at a spreading rate of 30 tonnes per hectare. A spread rate of 30 tonnes per hectare has been used to reflect similar calculations used in Defra's RB209 guidance document. The maximum value of each individual element in any sample collected was used to calculate the maximum spread rate of that element.

These spread rates are then compared with fertiliser recommendations from RB209, permit restrictions for spreading of nitrogen to land (250 tonnes per hectare) and annual limits for spreading of PTEs to soil as specified in the Codes of Good Agricultural Practise guidelines for soil. These limits are derived from those used in the Sludge (Use in Agriculture) Regulations 1989.

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<sup>1</sup> The Publicly Available Specification 100 (BSI PAS 100) for composted materials was sponsored by WRAP and developed in conjunction with the [Association for Organics Recycling](#) (AFOR).

Unfortunately some of the data has been slow in being submitted and some parameters requested were not analysed which has led to some missing data being presented.

Additional data has been collected on the quality of street sweepings that have been composted from the following sites, although these are used to illustrate contamination levels rather than being used as part of the results of the trial.

### Visual Assessment

Additionally some sites completed a table illustrating the visual level of contamination from grit and litter in each load of waste. This has been quite useful in gaining some perspective on what each batch actually contains, although the data is imprecise due to the very nature of visual monitoring.

The tables show the following variation in content of the leaf litter being received. The average volume of leaves was around 93%, soils and grit 3% and recyclables 0%. The grit levels appear to increase towards the end of the season.

Table 1 Visual assessment of leaf litter inputs to trial

Site	Leaf Litter %	Other green waste %	Soil %	Grit %	Recyclables %	Residual waste %	Other %
1	85 – 100	0	0 -10	0 - 10	0	0	0
2	85 – 100	0	0 -10	0 - 10	0 - 2	0	0

### Nutrients

The nutrient levels in the leaf litter composts produced during the trial are outlined in Table 2 below. The nutrient contents appear to be highly variable and do not appear like they would be the limiting factor in spreading to land on many occasions.

As would be expected, the nitrogen, phosphate and potash content are generally good in terms of crop requirements from compost.

Table 2 – Nutrients

Result	No of samples	Min	Median	Max	Max kg/ha spread at 30 t/ha	COGAP Annual Limits kg/ha
Ammonium N (mg/kg)	24	0	0	250		
BOD	3	6700	7050	7450		
Dry Matter %	84 <sup>2</sup>	39.16	54	76.8		
E. Conductivity (µS/cm)	4	368	484	877		5000
Nitrogen Total (%w/w)	43	0.35	1	1.41	250	250
Nitrogen Total (mg/kg)	29	368	690	3430	72	250
pH	64	6.76	7	8.86		
Phosphorus P (mg/kg)	71	32.6	903	3127	132	
Potassium K (mg/kg)	72	28.7	1029	4011	107	
Sulphur total (mg/kg)	24	1244	1356	1835	96.75	
TOC (% w/w)	3	7.32	10	15		

<sup>2</sup> Please note some data was provided without dry matter content therefore a figure of 50% was used.



### Potentially Toxic Elements

The results for PTEs indicate some areas of concern in comparison to both the PAS 100 standard and the COGAP guidelines for spreading waste to land.

In relation to the production of quality compost, the maximum levels of cadmium, chromium, copper, nickel and zinc found in the compost are at or above the upper limit specified by PAS 100. In the case of nickel the median value is also above the PAS 100 upper limit.

In relation to spreading the leaf litter compost, chromium, copper and nickel are above the COGAP guidelines for annual limits for spreading at 30 tonnes per hectare. Molybdenum is also at the annual limit whilst zinc is elevated but not above these limits.

Table 3 – PTE

Result	No of samples	Min	Median	Max	PAS 100 Upper limit mg/kg dry matter	Max kg/ha spread at 30 t/ha	COGAP Annual Limits kg/ha
Arsenic (mg/kg)	24	3.54	7	9.03		0.15	0.7
Cadmium Cd (mg/kg)	65	0	0	1.5	1.5	0.02	0.15
Calcium total (mg/kg)	3	26036	27300	27605		582.19	
Chromium Cr (mg/kg)	44	18.9	63	762	100	17.46	15
Copper Cu (mg/kg)	85	10.2	46	697	200	10.51	7.5
Fluoride Fl (mg/kg)	3	10.3	22	115		2.43	20
Lead Pb (mg/kg)	65	10.6	36	210	200	1.59	15
Magnesium Mg (mg/kg)	44	204	6556	14554		553	
Mercury Hg (mg/kg)	51	0	0	0.08	1.0	0	0.1
Molybdenum MO (mg/kg)	3	1.42	2	9.5		0.2	0.2
Nickel Ni (mg/kg)	65	6.8	32	353	50	8.09	3
Selenium Se (mg/kg)	3	0.09	0	0.13		0	0.15
Sodium (total) (mg/kg)	23	105	879	1524		28.03	360
Zinc Zn (mg/kg)	84	33.5	160	623	400	13.44	15

As a result every sample analysed for those four heavy metals has annotated in the following graphs to illustrate the distribution of results and highlight anomalies. The x axis shows the sample reference number only.

### Cadmium

As noted above, there is one cadmium result that is at the PAS 100 limit but all other levels are below this (Figure 1). By contrast no results are above the COGAP recommended spreading limit (Figure 2).

Figure 1 Distribution of cadmium in leaf litter compost

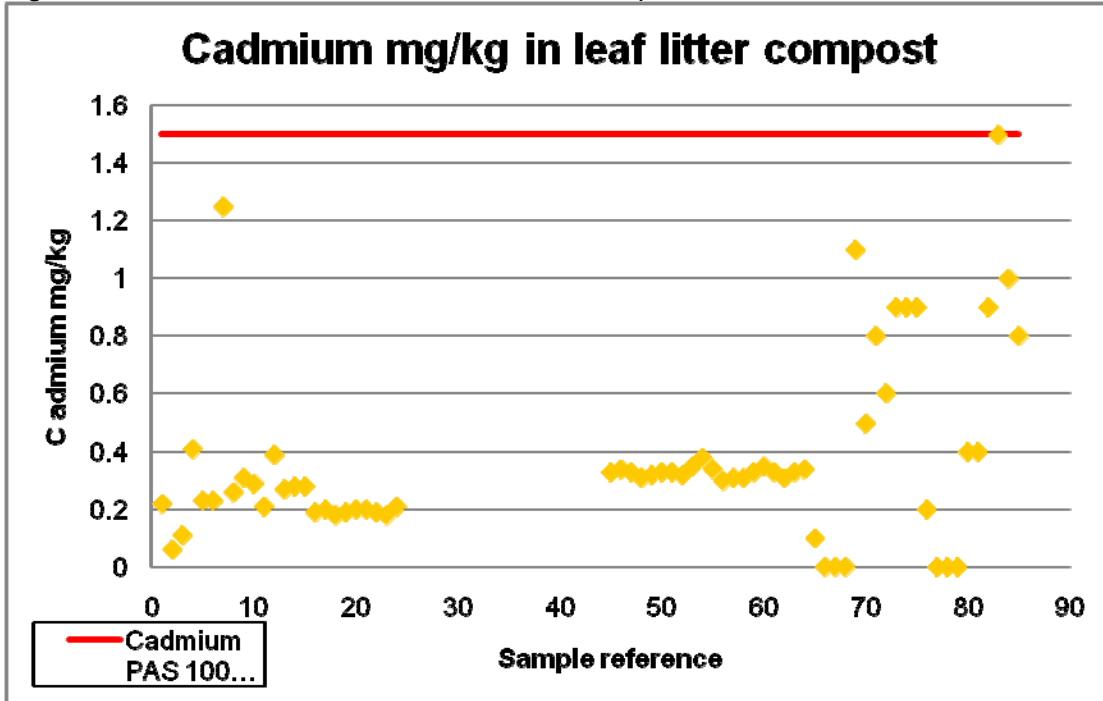
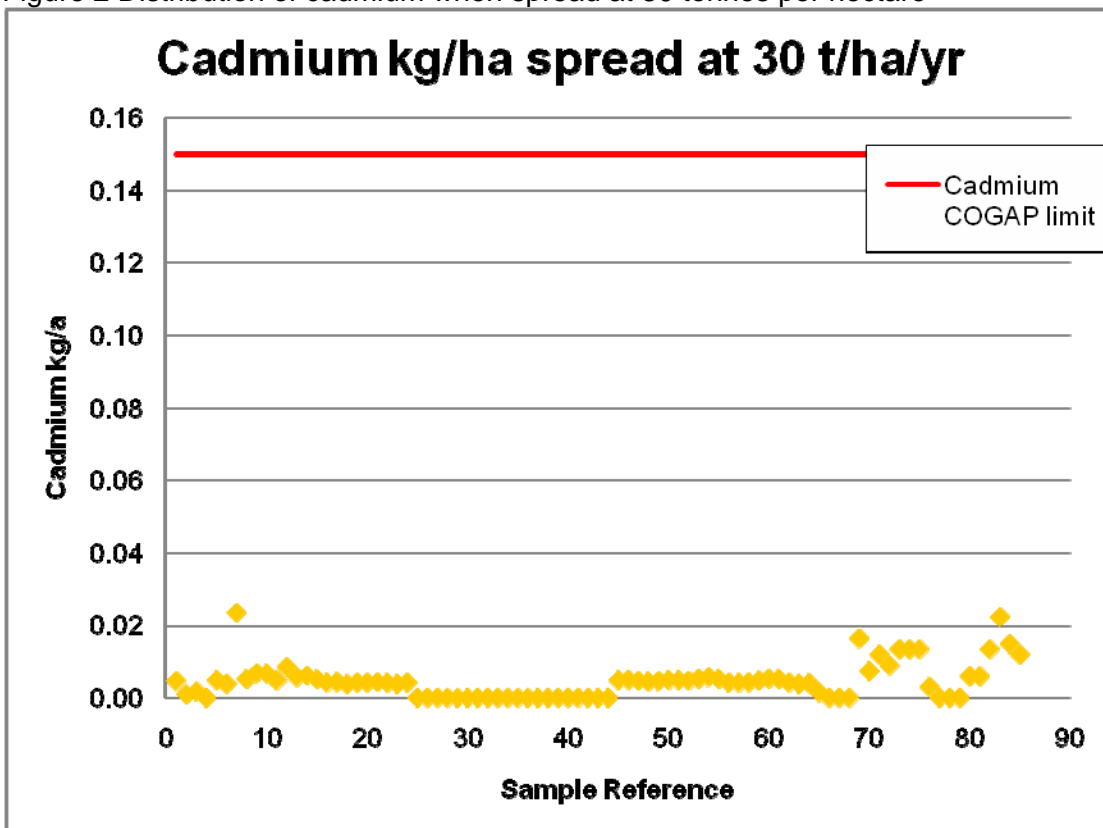


Figure 2 Distribution of cadmium when spread at 30 tonnes per hectare



### Chromium

Chromium levels in some of the leaf litter composts are well above that prescribed by the PAS 100 standard (Figure 3). However, chromium is generally at acceptable levels for spreading to land, but has exceeded the COGAP in one sample (Figure 4).

Figure 3 Distribution of chromium in leaf litter compost.

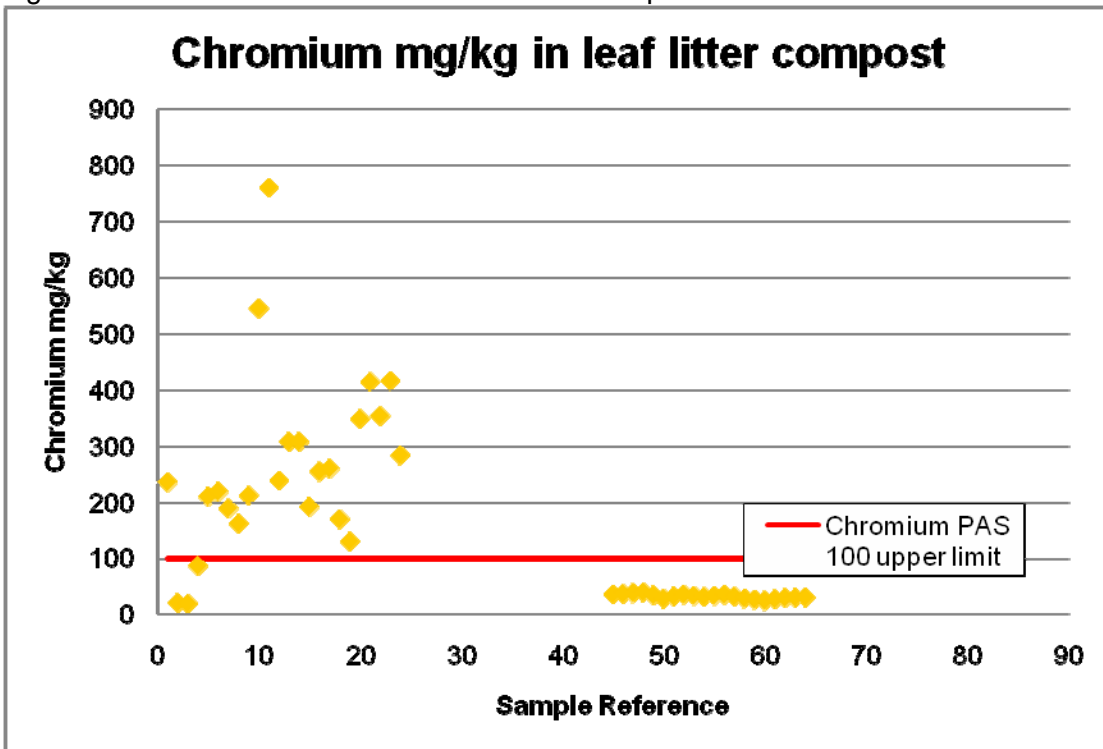
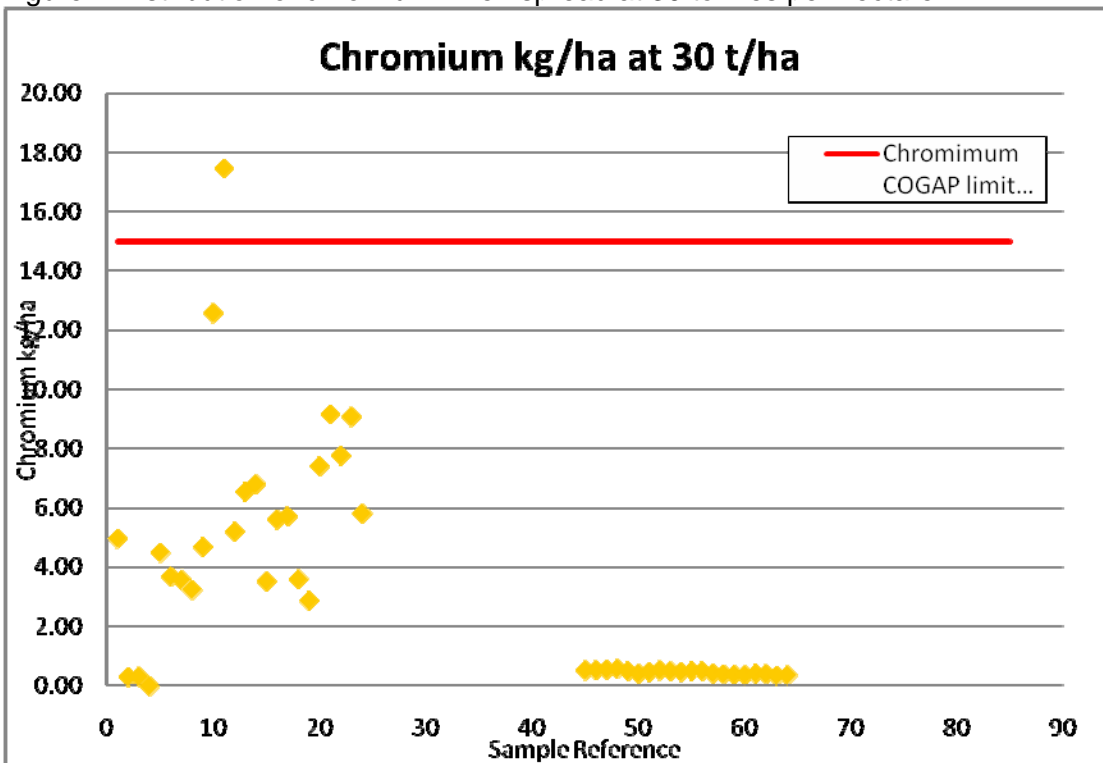


Figure 4 Distribution of chromium when spread at 30 tonnes per hectare



### Copper

Copper has exceeded the PAS 100 standard and COGAP guidelines in one sample only which appears to be an anomaly (Figures 5 and 6). This sample was from a batch collected very early in the season but no explanation for the result can be provided.

Figure 5 Distribution of copper in leaf litter compost

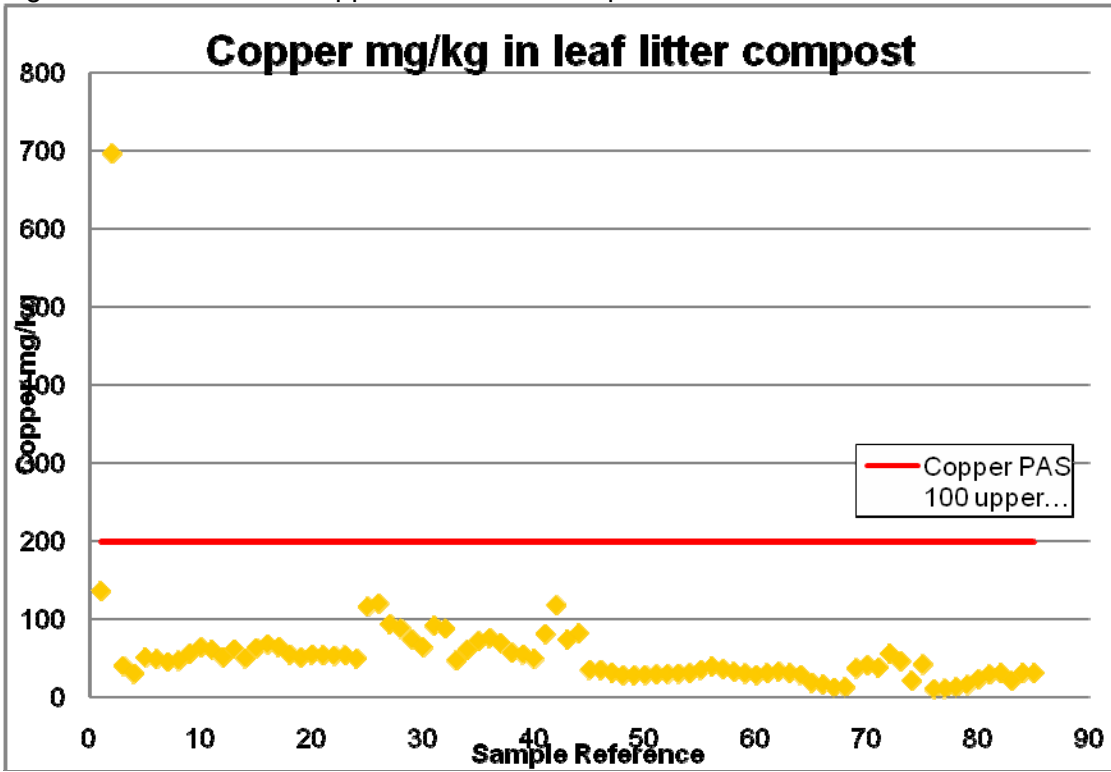
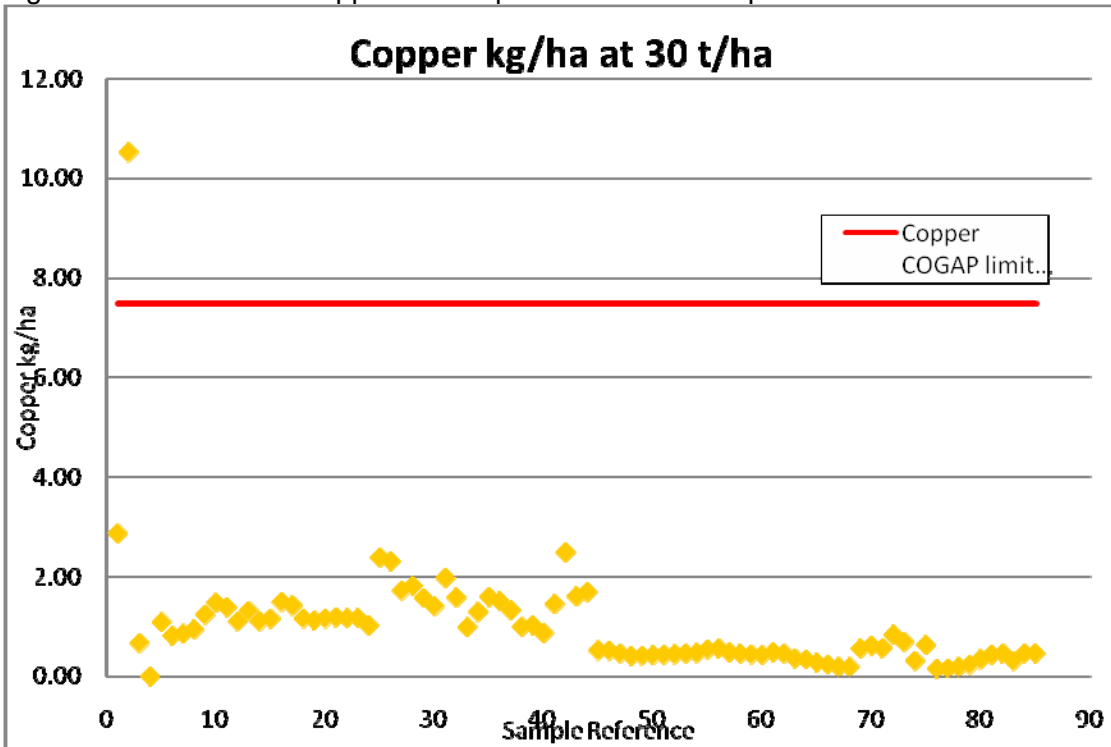


Figure 6 Distribution of copper when spread at 30 tonnes per hectare



## Nickel

It can be seen in that nickel levels are significantly above the PAS 100 standard in some samples but not in others (Figure 7). In addition, nickel levels are close to or above the COP guidelines in many of the samples (Figure 8).

Figure 7 Distribution of nickel in leaf litter compost.

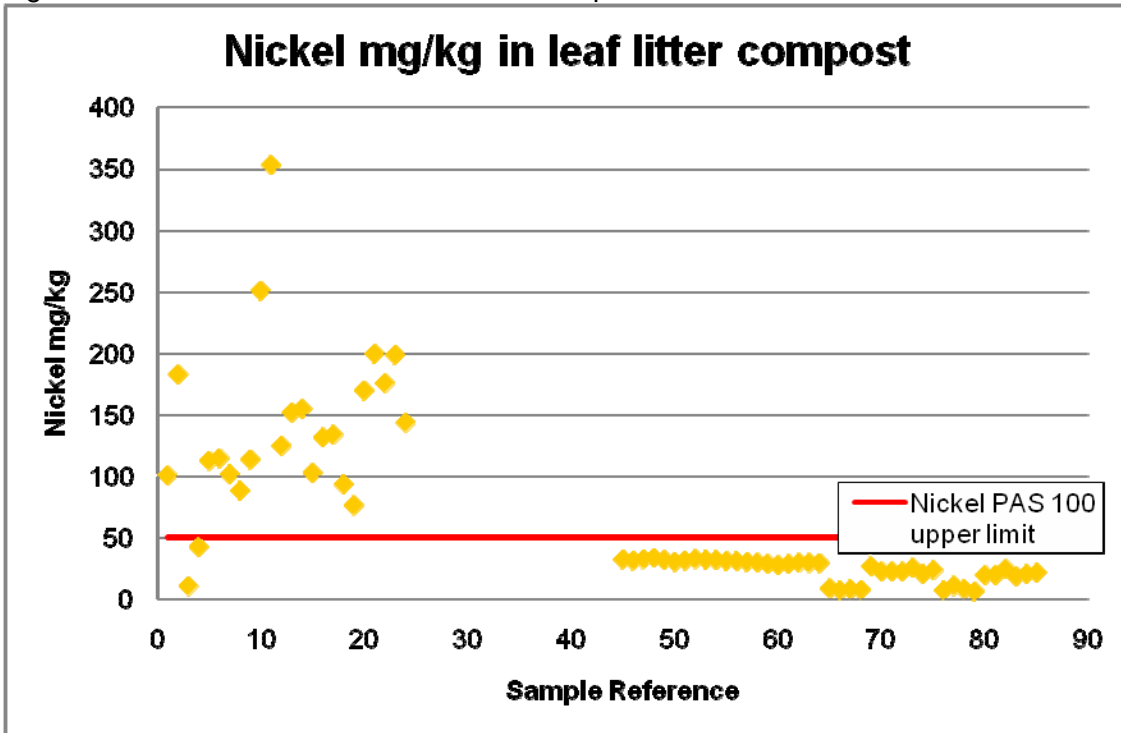
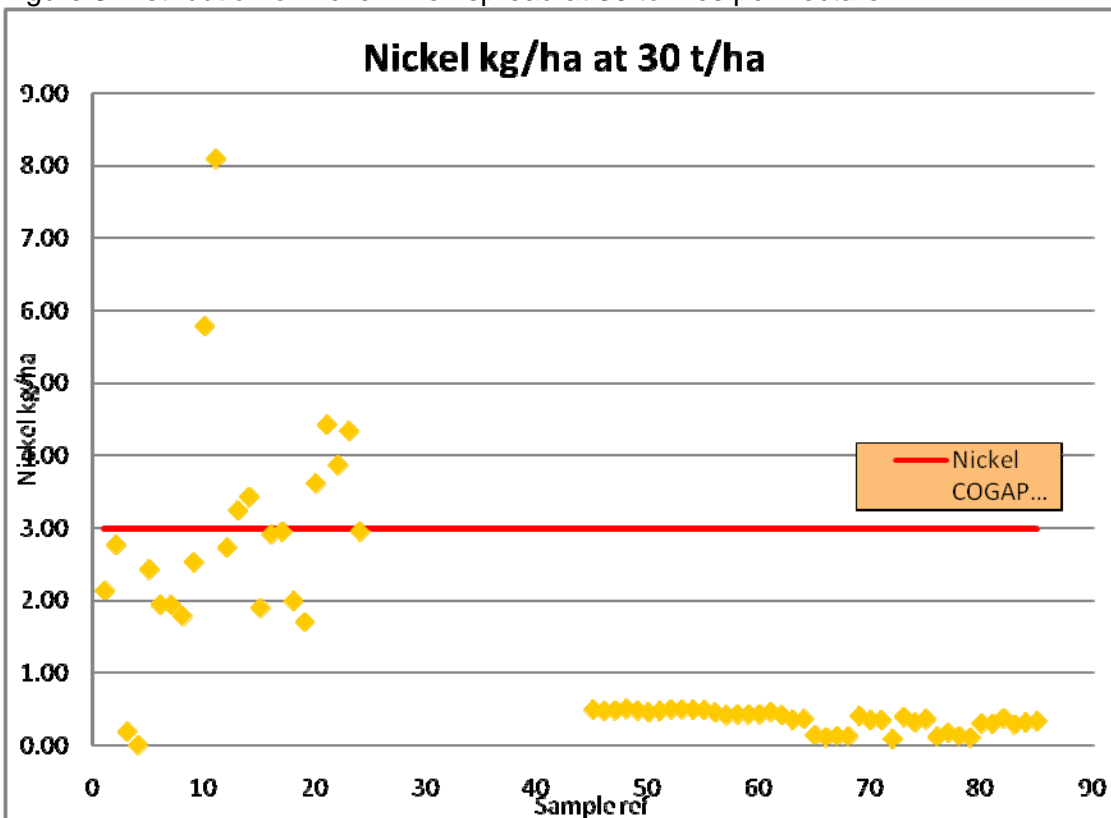


Figure 8 Distribution of nickel when spread at 30 tonnes per hectare



## Zinc

A number of samples were around or above the PAS 100 standard for zinc in quality compost (Figure 9). However, whilst zinc levels fluctuate between samples they do not exceed the COGAP guideline levels for spreading to land (Figure 10).

Figure 9 Distribution of zinc in leaf litter compost.

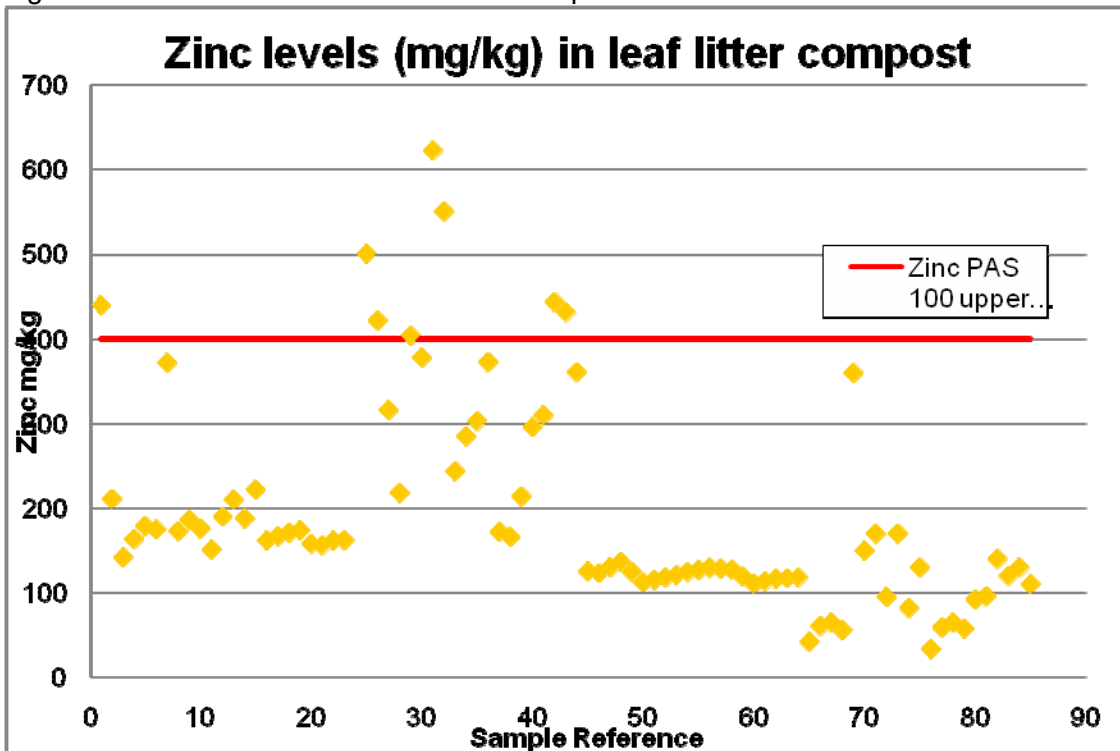
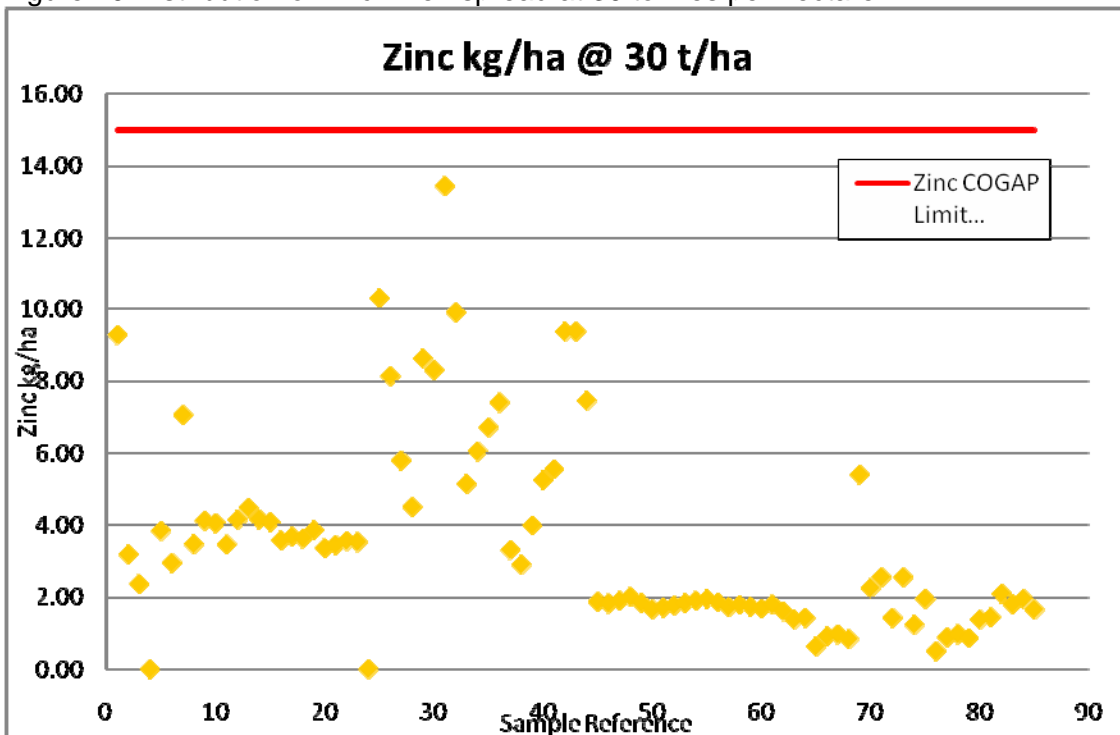


Figure 10 Distribution of zinc when spread at 30 tonnes per hectare



### Oils and hydrocarbons

Only limited data was submitted on hydrocarbons within the composts produced.

However, the data does show the presence of hydrocarbons within the untreated leaf litter compost. Where a breakdown has been provided the majority of the hydrocarbons were long chain oil range organics C21-C40 such as lubricating oils.

Table 4 – Oils, PAH and EPH

Result	No of samples	Min	Median	Max
Fats & Oils	1	0	0	0
PAH mg/kg	10	7.2	16	41.5
EPH - GC (mg/kg) (C10-C40)	10	599	1430	2525

## Analysis of untreated street sweepings

The following data was provided by local authorities across the country but were outside the scope of the Leaf Litter trial.

This data is presented separately because of a lack of information in relation to:

- when these street sweepings were collected i.e. if it was leaf litter only
- if the street sweepings were from urban or rural areas
- if street sweepings were treated prior to composting
- if the resultant compost was mixed with other wastes, e.g. green waste, for composting or after composting.

	No of samples	Min	Median	Max	PAS 100 Upper limit mg/kg dry matter
Dry Matter %	3	43	44	68	
Nitrogen Total (%w/w)	4	0.13	0	0.72	
Nitrogen Total (mg/kg)	8	368	1964	2507	
pH	13	6.8	7	8.72	
Phosphorus P (mg/kg)	12	38.2	271	887	
Potassium K (mg/kg)	12	46.5	128	2747	
Sulphate total (mg/l)	6	0	0	0.72	
Sulphur total (mg/kg)	8	0	0	1146	
<b>Heavy Metals</b>					
Arsenic (mg/kg)	6	2.71	7	12	
Cadmium Cd (mg/kg)	17	0	0	0.7	1.5
Chromium Cr (mg/kg)	6	9	26	30	100
Copper Cu (mg/kg)	17	10	14	28	200
Cyanide (mg/kg)	6	0	0	0.6	
Lead Pb (mg/kg)	17	10.6	26	63.1	200
Magnesium Mg (mg/kg)	4	252.3	5199	7979	
Manganese (mg/kg)	3	652	842	959	
Mercury Hg (mg/kg)	17	0	0	0.05	1
Nickel Ni (mg/kg)	17	6.6	9	22	50
Selenium Se (mg/kg)	6	0	0	0.8	
Sodium (total) (mg/kg)	3	504	693	3819	
Zinc Zn (mg/kg)	17	33.5	65	139	400
<b>Organic Compounds</b>					
PAH (mg/kg)	3	0	23	36	
Phenols Index (mg/kg)	6	0	2	4.74	
TPH (C10-C40) mg/kg	4	34	513	942	



## Analysis of recovered organic fraction from treated street sweepings

Data has been provided by one operator of permitted treatment facilities which treat street sweepings to recover separate fractions. This data was already held by the company and some general data for nutritional comparison has not been provided.

The heavy metal data provided is significantly lower than that produced in the leaf litter trial analysis and it would be useful to understand how the treatment process affects the level of these contaminants.

The predominant hydrocarbons are the longer chain lubricating oils, although at lower levels than found in the leaf litter trial.

	No of samples	Median	Max	Min	PAS 100 Upper limit mg/kg dry matter
pH	7	7	7.6	6.5	
Carbon	7	3300	11000	190	
Chloride	7	3100	4400	680	
Sulphate as S04	3	370	540	41	
Total Dissolved Solids (TDS)	7	22000	31000	2920	
<b>Heavy Metals</b>					
Arsenic (mg/kg)	7	0	0	0	
Cadmium Cd (mg/kg)	7	0	0.0037	0	1.5
Chromium Cr (mg/kg)	7	0	0.17	0	100
Copper Cu (mg/kg)	7	0	0.47	0.16	200
Fluoride Fl (mg/kg)	4	3	720	0.2	
Lead Pb (mg/kg)	4	0	1.7	0.051	200
Mercury Hg (mg/kg)	7	0	0	0	
Molybdenum as Mo	7	0	0.24	0	
Nickel Ni (mg/kg)	4	1	1.3	0.04	50
Selenium Se (mg/kg)	7	0	0.1	0	
Zinc Zn (mg/kg)	7	1	12	0	400
<b>Hydrocarbons</b>					
PAH (mg/kg)	7	70	210	20	
TPH (C10-C40) mg/kg	7	570	1300	85	
EPH >C21-C40, Aliphatic	4	215	310	150	
EPH >C6-C40, Total Aliphatic	4	230	330	160	
EPH >C21-C40, Aromatic	4	140	210	99	
EPH >C6-C40, Total Aromatic	4	165	240	120	
EPH >C6-C40, Total	4	425	530	280	

## Conclusions

The leaf litter trial has provided a small dataset which shows areas of concern in relation to nickel, copper, chromium and zinc. However, not all of the data has been submitted and the data has also not been validated effectively in terms of the sampling methodology. There is also some abnormality in data between local authorities where the source of contamination is not understood.

The outcomes from this trial signal the need for a precautionary approach to composting of this waste. This is due to the presence of metals such as nickel, copper, chromium, molybdenum, zinc and other contaminants. Our current guidance therefore remains unchanged.

However, data provided by other local authorities outside of this trial and two operators of treatment facilities appear to be significantly lower in contamination. Further information is required to assess whether the treatment activities themselves are removing this contamination and also to identify the source of this contamination.

Following the publication of the guidance on street sweepings and gully suckings there has been some interest in the results of this trial expressed by local authorities in England and the Association for Organics Recycling. We have also written to all of our operators to ensure that they are aware of the guidance and to help them comply with their permits.

We do not want to un-necessarily restrict the recovery of organic matter where it is possible but we do want to be cautious where this recovery may cause an impact to our agricultural land. We will continue to review evidence provided on the composting of separate leaf litter collections. We are working with the industry about this. Local Authorities interested in undertaking trials for composting of leaf litter can contact AfOR (Association for Organics Recycling) who have expressed a willingness to oversee trials.

## Recommendations

A further trial should be conducted using a larger number of contributing local authorities but with greater control. This trial should also be extended to assess how different treatment methods impact on contamination levels within leaf litter and also organic fractions from street sweepings. Industry would be required to coordinate such a trial through AFOR.

The Environment Agency will internally use the Biowaste sector group to continue to explore the treatment and recovery options for this waste.

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